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turn, again trigger electrons, so that it results in an electron avalanche running on the insulator surface toward the anode, which electron avalanche can cause considerable interference, depending upon the circumstances also gas eruptions or even a snapping of the insulator. The higher the voltage, the more significant this effect becomes. Therefore, at very high voltages, this type of insulator can no longer be used. This effect occurs less cathode-side since electrons which reach the insulator surface cathode-side, or are released therefrom, move through the vacuum in the direction of the metal cylinder and not along the insulator surface. In the state of the art different solutions are known for avoiding the disadvantage at the anode part. Proposed in the publication DE 2506841, unexamined with respect to substance, for example, is that the insulator cathode-side be designed such that a conical cavity is formed between the insulator and the tube. Another solution of the state of the art is shown e.g. in the patent publication EP 0 215 034, where the disc-shaped insulator is graduated toward the metal cylinder in a step-like way. It has been demonstrated, however, that all the solutions shown in the state of the art have operational faults at high voltages, i.e. for instance over 150 kV, which lead to a premature aging of the material, among other things, and can cause gas eruptions and/or snapping of the insulator. Thus for many modern applications of X-ray tubes at very high voltages (>200 kV) the insulators known in the state of the art are only poorly usable.

It is an object of this invention to propose new insulators for high voltage vacuum tubes and a method for producing such insulators which do not have the drawbacks described above. In particular a long life and a failure-free operation should be ensured also at very high voltages with small or compact construction. The high voltage vacuum tubes are intended, among other things, for use as X-ray tubes for x-raying baggage and/or transport containers, etc., and should meet the industrial demands necessary there.

These objects are achieved according to the present invention in particular through the elements of the independent claims. Further preferred embodiments follow moreover from the dependent claims and from the specification.

In particular these objects are achieved in that in a high voltage vacuum tube an anode and a cathode are disposed opposite one another in a vacuumized inner space, in that the vacuumized inner space is enclosed by a cylindrical metal housing, and in that the anode and/or the cathode are

5 electrically insulated by means of an annular insulator, the annular insulator comprising a cylindrical part and being designed arched once, humped in direction of the vacuumized inner space, the arch comprising in direction of the vacuumized inner space a front area sloping with respect to the axis of symmetrical rotation of the annular insulator, and two lateral areas, the sloping

10 front area of the annular insulator of the anode being sloping toward the disc center of the annular insulator, and the sloping front area of the annular insulator of the cathode being sloping away from the disc center of the annular insulator. In particular the insulator(s) according to the invention can be designed alternatively either cathode-side only, or anode-side only, or on both

15 sides, i.e. on the side of the anode and on the side of the cathode. One lateral area each of an insulator slopes toward the respective negative electrode, and runs over a larger region in its vicinity. At the anode, the wall of the cylindrical metal housing forms the negative electrode with respect to the insulator, while at the cathode the metallic outer wall of the cathode forms the negative

20 electrode with respect to the insulator. The connection point between the respective negative electrode and the corresponding insulator is designated as the negative triple point. The high voltage vacuum tube can be used e.g. as an X-ray tube. The above-mentioned design has the advantage that during operation an extraordinarily high stability of the tube is achieved through the

25 arising electrical field, without resulting in breakthroughs in the insulator anode-side and/or cathode-side, gas eruptions and/or other malfunctions. At the same time the tube can be operated at much higher voltages and with smaller or respectively more compact construction than conventional tubes. The dimensions of the tube and the voltage at the insulator are in a direct

30 relationship to one another. The smaller the construction, the greater the insulator's capability must be to withstand voltage at the electrode. The advantages of a smaller and more compact construction for such tubes are evident. Smaller and more compact tubes are cheaper to produce, are less heavy, and easier to handle. This especially concerns e.g. any necessary lead

35 shielding, etc. Achieved through the special form of the insulator is that a

Claims

1. High voltage vacuum tube (9), in which an anode (3) and a cathode (4) are disposed opposite one another in a vacuumized inner space (6) and which vacuumized inner space (6) is enclosed by a cylindrical metal housing (1), the anode (3) and/or the cathode (4) being electrically insulated by means of an annular insulator (21/22), characterized

in that the annular insulator (21/22) comprises a cylindrical part (23/24), and is designed arched once, humped in direction of the vacuumized inner space (6), the arch comprising in direction of the vacuumized inner space (6) a sloping front area (31) and two lateral areas (30/33),

in that the sloping front area (31) of the annular insulator (22) of the anode (3) slopes toward the disc center (7) of the annular insulator (22), and

in that the sloping front area (31) of the annular insulator (21) of the cathode (4) slopes away from the disc center (7) of the annular insulator (21).

2. High voltage vacuum tube (9) according to claim 1, characterized

in that the arch is substantially characterized by angles α , β and γ of a shortened lateral area (30), of a raised lateral area (33), and of a front area (31),

in that the angle γ between the axial direction (7) of the annular insulator (21/22) and the shortened lateral area (30) is between 10° and 25° ,

in that the angle β of the front area (31) to the perpendicular (8) to the axial direction (7) of the annular insulator (21/22) is between 10° and 25° , and

in that the angle α between the raised lateral area to the axial direction (7) of the annular insulator (21/22) is between 10° and 25° .

3. High voltage vacuum tube (9) according to claim 2, characterized in that the three areas (30/31/33) each have a tangential transition radius (R1/R3) of 1 to 7 mm.

5 4. High voltage vacuum tube (9) according to one of the claims 1 to 3, characterized in that the annular insulator (21/22) has a fourth area (32) between the raised lateral area (33) and the front area (31), sloping with respect to the perpendicular (8) to the axial direction (7) of the annular insulator (21/22), which fourth area points substantially perpendicularly (8) to the axis (7) of the annular insulator (21/22) in the direction of the vacuumized inner space
10 (6), and which has a tangential transition radius (R2/R3) of 1 to 7 mm to the raised lateral area (33) as well as to the front area (31).

5. High voltage vacuum tube (9) according to one of the claims 1 to 4, characterized in that the raised lateral area (33) projects into the vacuumized inner space (6) at least twice as far as the shortened lateral area (30).

15 6. High voltage vacuum tube (9) according to one of the claims 1 to 5, characterized in that the raised lateral area (33) has a tapering termination toward the axial direction (7) of the annular insulator (21/22).

7. High voltage vacuum tube (9) according to one of the claims 1 to 6, characterized in that the shortened lateral area (30) has a tapering
20 termination toward the axial direction (7) of the annular insulator (21/22).

8. High voltage vacuum tube (9) according to one of the claims 1 to 7, characterized in that the annular insulator (21/22) is substantially composed of an insulating ceramic material.

9. High voltage vacuum tube (9) according to claim 8, characterized
25 in that the ceramic material of the annular insulator (21/22) is composed of at least 95 % Al_2O_3 .

10. High voltage vacuum tube (9) according to one of the claims 1 to 9, characterized in that the cathode (4) comprises an electro-polished and/or

mechanically polished metal cylinder (412) on the outer wall (411) facing the annular insulator (21).

11. High voltage vacuum tube (9) according to one of the claims 1 to 10, characterized in that the high voltage vacuum tube (9) comprises a power
5 supply device, by means of which operational voltages of at least 200 kV are able to be applied at the insulator.

12. High voltage vacuum tube (9) according to one of the claims 1 to 11, characterized in that the high voltage vacuum tube (9) is an X-ray tube.

13. Method of producing a high voltage vacuum tube (9) according to
10 one of the claims 1 to 12, characterized in that a pressing power of at least 1000 bar is used to produce the annular insulator (21/22).

14. Baggage x-raying device, characterized in that it comprises a device for generation of X rays, the device for generation of X rays comprising at least one high voltage part and one or more X-ray tubes according to one of
15 the claims 1 to 13.

15. X-raying device for transport containers and/or transport vessels, characterized in that it comprises one or more X-ray tubes according to one of the claims 1 to 14 for generating X rays.